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Round Table

THE CHEMISTRY OF FOOD PRODUCTION

An NBC Radio Discussion by JOHN H. FOULGER
HUGO RIEMER, BERNARD SCHWEIGERT
and HOWARD C. SPENCER

Including

THE IMPORTANCE OF HEALTH IN INDUSTRY

By JOHN H. FOULGER

NUMBER 841 ✶ MAY 23, 1954 ✶ *10 cents*
Yearly subscription $3.00

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THE UNIVERSITY OF CHICAGO ROUND TABLE

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The University of Chicago ROUND TABLE. *Published weekly. 10 cents a copy; full-year subscription, 52 issues, three dollars. Published by the University of Chicago, Chicago 37, Illinois. Entered as second-class matter January 3, 1939, at the post office at Chicago, Illinois, under the Act of March 3, 1879.*

The Chemistry of Food Production

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MR. SCHWEIGERT: Most of us probably never think of how greatly our food fashions and eating habits have changed in the last fifty years. We think of food as being just food, like it always has been. We never hear very much about what new chemical discoveries are doing in growing and protecting food. But the ROUND TABLE today has chosen to recognize National Chemical Week by bringing together as today's discussion participants three of the outstanding leaders in the field of chemistry of food production, so that we may all have an opportunity to find out what is happening to the food we eat.

Dr. Foulger, what is your interest in this subject?

DR. FOULGER: I am interested in health. For about nineteen years I have been concerned with health as it may be affected by chemical processes or the use of chemicals in all phases of our daily life. In the use of chemicals in the production of food we face many problems—in medicine, in laboratory techniques for testing chemicals, and even in the philosophy of law. We must solve these problems if we are to continue to produce an abundant supply of wholesome, palatable, and attractive food.

MR. SCHWEIGERT: Mr. Riemer, how do you fit into this particular picture?

MR. RIEMER: I do not have the glamour that some of these other fellows have. I am really the man with the pitchfork, behind the farmer, who is the food producer. In other words, my prime interest in the chemical field is fertilizers. My company was the pioneer in the manufacture of synthetic nitrogen from the air and has been at it for something over forty years. Of course, in that time we have been interested in research on the manufacture of nitrogen, on the manufacture of other forms of fertilizers, and also on the use of the fertilizers to get the best out of them that there is.

MR. SCHWEIGERT: Mr. Spencer, how about you?

MR. SPENCER: I am vitally interested in the development of agri-

cultural chemicals—those chemicals which are effective in the production of food crops and in their storage—as well as being interested in all chemical products which are useful in food processing and food packaging.

MR. SCHWEIGERT: At the University of Chicago, in the American Meat Institute Foundation, with which I am particularly concerned, we are very much interested in a number of these new processing methods, and we have a rather extensive program going on, trying to find out some of the chemistry of these particular food-processing methods.

Are the advances being made by chemistry in the field of food production at the present time keeping up with the growth of population in America?

MR. RIEMER: Yes, I think that we can say categorically that they are. All you have to do is to look at the development of fertilizers, insecticides, weed-killers, and other things of that kind—the new things which are coming out all the time and the hope which there is in it.

DR. FOULGER: Are we actually merely increasing the absolute quantity of food production? Are we really advancing in production of specific types of foods, remembering of course that a proper diet must be an all-rounded affair and not merely a mass of food?

MR. RIEMER: I think that we are going farther than mere quantity. There is a good deal involved in the work which the chemicals do in improving quality, in the changing of food types, which I think will march right along with the people who tell us what the balanced diet ought to be.

MR. SCHWEIGERT: Balanced diets then would require a concept not only of the quantity of food but of the quality of food?

MR. RIEMER: Yes, there is no question about that.

MR. SCHWEIGERT: Currently America has a surplus of food about which many of us have heard a lot and know something about, perhaps. How has chemistry aided in creating this fact?

MR. RIEMER: I do not think that we ought to say that chemistry has created the surplus. The surplus is an economic condition largely. But let us look at it from my standpoint—the fertilizer standpoint. Chemistry's contribution has been in the increasing of production per acre. When we talk about quantity, it is the increase in production per

acre which permits the farmer to produce food at lower cost—permits him to maintain his level of income or possibly even to increase it, even though his rate of income and his market may be declining. That, I think, is the significant contribution of fertilizer chemistry to the farmer. As a matter of fact, the farmer will confirm that, on the average, he can get back three dollars and fifty cents for every dollar he puts into fertilizer. That is a pretty good return on your money.

MR. SCHWEIGERT: It would also depend, it would seem to me, on what type of crop the farmer was getting the greatest price for as to what he produces. Certainly that must have some answer to cumulating surpluses.

MR. RIEMER: Yes.

MR. SPENCER: And, in that regard, how do you think fertilizers would have a role in changing the type of cropping in the dust-bowl area?

MR. RIEMER: Fertilizers can make it possible for the farmer—and the law of supply and demand may well force him to this—to shift his crop from grains to grass and grow meat rather than grow grains. Our diets are switching in the direction of meats and proteins anyway, so that the farmer has a real possibility of saving himself in the dust bowl and using these chemical fertilizers and so on for that purpose.

MR. SPENCER: What part may the soil conditioners play in this whole matter of controlling the dust bowl?

MR. RIEMER: That, I think, is a matter for the future. It is a little hard to tell about the soil conditioners now. The ones which we have had so far are pretty expensive for agricultural use. They may do all right on your home lawn, in your home garden, or your window box, where your cost per unit is not so important; but they are pretty high-cost now, and something has to be done to develop cheaper ones before they will really be an agricultural product.

MR. SCHWEIGERT: I heard recently that it might cost as much as three thousand dollars an acre to treat with soil conditioners at the present time. With land at a hundred to three hundred dollars an acre in the Midwest, it will probably be some time before they will be effective, if even then, do you not agree?

MR. RIEMER: Oh, yes. But at that end it would make a gold-plated land.

DR. FOULGER: Would it not be cheaper to ship the land for top soil to the East where we need it rather than to invest money in soil conditioners?

MR. RIEMER: I think cheaper than doing that would be to buy more fertilizer in the East and make your land better.

MR. SPENCER: Is not the actual solution out in the dust bowl to turn it back to grazing and raise high-quality pasture for better production of meat and for better and better meat than we actually need at the present time?

MR. RIEMER: That to me is what today's indicated solution is. What will happen later one cannot tell, of course. Soil conditions may improve.

MR. SPENCER: Another thing in this whole matter in production of crops I believe is pesticides. Pesticides play a very real part in preventing the destruction of crops which are growing or the food after it has been produced and put in storage. The great number of newer pesticides which we now have, have done a great deal to help in this over-all matter of producing more and better and higher-quality foods for the American people.

MR. RIEMER: What kind of pesticides do you have in mind? Do you mean DDT and things like that?

MR. SPENCER: I mean the whole range, starting with DDT, and then many of the newer organic pesticides which have come in since that time. We have a whole gamut of those. They are quite specific for certain insect pests, and they do do an excellent job in controlling insect pests in a growing crop or in the stored crop.

MR. SCHWEIGERT: These weed-killers which have been used, particularly in the South, have always fascinated me. Presumably they are really coming ahead rapidly.

MR. SPENCER: Weed-killers are a very real boon to the farmer—a boon in many ways. We have a pre-emergent type weed-killer which can be put on at the same time as seeding so that it holds down the grass or the weed at the time the seedling is getting its start, giving the seedling a very great head start over the weed.

And then later on, of course, you can use it during the rapidly growing portion of the lifetime span of the plant, cutting down on a grea

deal of hand labor which might be required in cultivating. It is actually a chemical means of cultivation, and the chemical weed control helps a great deal with all this hand weeding and hand labor.

DR. FOULGER: We have talked about protection of growing crops by pesticides and weed-killers. We face another problem—protection against rodents, such as rats. That has been a very difficult problem over the years. And, as I remember it, quite a range of chemicals have been tried. We face two problems: the problem of rat infestation of big cities and the problem of rats on the farm.

So far as cities are concerned, I doubt whether we have been too successful. A few years ago a chemical rodenticide, to use the technical term, was hailed as being the answer to the problem; but use of it in a large city in the East showed, first, that it killed only one particular species of rat and, secondly, that if a particular rat did not eat enough to kill it, it was thereafter immune. In other words, we face the same problem of production of immunity as we face in the use of some insecticides. Are there any other compounds than this one, which was called "N-2," which are more successful?

MR. SPENCER: There are some newer rodenticides, as you call them, which are much more effective. Warfarin might be an example. We should say that chemical rat killers are not the whole answer. Surely you cannot kill off all the rats in the world by the use of poisons or by chemicals. But by the use of good sanitation practice, by the matter of removing the food supply of the rat, by proper ratproofing of your premises, you can control rats very well in limited areas—warehouses, food-storage areas, and that type of thing. Chemicals do play a part.

MR. SCHWEIGERT: You are thinking there about keeping stuff in the garbage can then?

MR. SPENCER: That is the most important thing so far as the householder goes. He surely cannot kill all the rats in the alley, but he can protect or remove the food supply of the rat. Then, by controlling them in the limited areas, he can go a long way toward reducing the rat population of cities and areas.

DR. FOULGER: Of course, we cannot forget one other thing too; at least I cannot. The rat is a carrier of disease.

MR. SPENCER: That is most important.

DR. FOULGER: And in the conservation of our food supply and protection against rat-carried diseases, it is extremely important.

MR. RIEMER: What it comes down to, though, is that you cannot really do anything about the rat situation unless you build your buildings right, keep them sanitary, and keep the streets sanitary.

MR. SCHWEIGERT: It is important to keep them out of the food after you process it too.

MR. SPENCER: We have another very important development in rat control, and that is our newer packaging materials—cartons and cardboard, and that type of thing—which have been treated either to repel rats or to kill rats. I think that we can do a great deal toward protecting food by treating the carton. It also leads into the very broad field of food packaging. Many excellent developments have been made in the last few years so far as better packaging of foods, so far as the matter of solid containers, rigid containers, the whole plastic-film industry, the laminate industry, and so on.

MR. SCHWEIGERT: That has really gone over with the housewife; I can assure you of that.

Riemer, what about these food supplements?

MR. RIEMER: Supplementing animal food, particularly for cattle, is one field in which I am interested. That is using urea as a protein substitute. It is not exactly a protein. It is a substitute, as I say, because it works in the first stomach of the cow to develop the protein material which the cow needs for its food. Some of the farmers in Iowa and some of our other cattle-growing countries have been experimenting with urea. The corncobs that are built up in big heaps on the farms and urea are mixed with molasses as a wintertime cattle feed. Some have had courage in making these experiments, but I think that they belong right in the chemical industry in their willingness to do that, and they have had some pretty good results.

MR. SCHWEIGERT: You have really indicated by that a challenge to research in the meat industry as well as other aspects of crop production. What is the composition of the gain of an animal which has been fed a ration of this diet or, in fact, any other type of food supplement? Or, we go even further than that, on any kind of a ration at all? It seems to me that we have so little information on that and on the question of what is the best sort of food to feed an animal to get the best kind of food to put on the table for the human being.

MR. SPENCER: You bring up a very important problem there. We are

all familiar with the old story of vitamin supplementation, enrichment of minerals, and that type of thing. Now we are coming right in the whole field of taking poor protein quality foods and enriching or supplementing them with some of the essential amino acids, such as lysine, tryptophane, or methylamine, and making a high-quality protein.

DR. FOULGER: But there is another question in this problem of using supplements and increasing the weight of animals. I understand that the animals are actually sold by weight and that the incentive to use materials of that type is to attain a greater weight for a given animal or bird in a shorter time for purely marketing purposes. We need to know whether that increased weight is really increased nutrition or merely increased water or increased bone. Do we know that yet?

MR. RIEMER: I do not know whether we know it entirely, but I think that we have some indication that the urea as a feed supplement does increase the protein value of the meat. We even have an indication that the protein value of corn is improved by the use of nitrogen fertilizer; and, although there is still a lot of studying to be done, it is a field about which I do not think that we need be discouraged. There is a good promise in it.

MR. SCHWEIGERT: We have to be awfully careful there about commenting on increasing the protein in the meat. What we should say is that the protein quality of meat, with these supplements, is equivalent to that when the supplement is not used, for the protein composition is actually very constant. But the problem of ratio of protein, the moisture to fat, to which Dr. Foulger referred, is very vital, because it seems to me we ought to come sometime to the stage that, when we buy an animal food or a vegetable on the market, we know a little bit more about what that pound was made up of. After all, that is where the nutrients really are, in each pound of that particular material.

MR. RIEMER: You are suggesting to me that I cannot make a silk purse out of a sow's ear, and I am not so sure that that is not going to be true, that we are going to be able to do something like that. There is not very much limitation to what the chemical industry with its ingenuity and its capital can do.

DR. FOULGER: When we talk of supplements, it seems to me that we come into the question, which I mentioned before, of legal philosophy. As a matter of fact, the Federal Food, Drug, and Cosmetic Act of 1938,

which governs the movement of food in interstate commerce, divides materials, as you might call chemicals in foods, into two classes—those which are required and cannot be avoided in production and processing of food and those which are deliberately added for some purpose or other but are not required. Those two classes are treated in quite a different way with respect to assessment of their safety. If it is decided that they are required, then they are subject to the setting of tolerances. That is, the Secretary for Health, Education, and Welfare can say: "I believe, from information given me over this particular range, that it is quite safe to use them," and they can be used under the law. But if the Secretary decides that they are not required, the test is quite different. In that case, it is the supplement itself which is tested and not the safety of the food in which it is placed. That supplement, to be acceptable under the law, must of itself in any quantity be free from the ability to produce harm. Now that produces quite an impasse, because even a natural food cannot be taken in any quantity without the possibility of producing harm. Tommy cannot eat all the apples he wants. I cannot drink all the water I want.

MR. SPENCER: In effect you are saying that all materials may have some deleterious property if taken in large enough concentration in certain modes of administration. Actually what we are interested in is demonstration of safety of any given chemical for its intended use.

DR. FOULGER: That is right. We are interested in safety of the food, and that means safety of the chemical for its intended use after it has been added to the food or whatever. But do not forget that we are limited by the law, and the law in this field does not allow that criterion.

MR. RIEMER: What you are shooting at really, I imagine, is the fact that the law should specify the standards specifically; there ought to be the same standard in order to encourage research and development of the new materials. Is that right?

DR. FOULGER: Yes. It seems to me that if you set up a criterion which cannot be met, you definitely hinder advances, and you lead to two situations which are not good: You lead to resentment and perhaps even contempt for the law, so that even good citizens try to avoid it. That is a bad situation. You may lead also to hesitation on the part of the administrating agency to enforce the law fully. Then we come

to a man deciding—not a law deciding—what should be done. That is government by men and not by laws, which is again a bad situation.

MR. SCHWEIGERT: It is clear that law and chemistry are pretty hard to differentiate from this particular discussion.

I would like to get back to this point about safety. It is very important that any chemical which is being added to a food be adequately tested. I know that industry, the government, and the universities are doing a tremendous amount of excellent work in demonstrating the wholesomeness of a particular food or a food supplement. That is a very important point.

MR. SPENCER: There is a great deal of work going on there in different laboratories; and I do believe that the toxicologists are coming to a better understanding of the criterion necessary to demonstrate safety. Certain national groups are giving a great deal of thought to this. The Food Protection Committee of the National Research Council might be mentioned as one group which is working on basic principles for judging safety and the matter of criteria in certain definite instances.

MR. SCHWEIGERT: I know that you are very active in that particular field. What are some of these criteria which people think of when they go about testing a food additive?

MR. SPENCER: That is a little hard to put down in a few words, but most certainly we are first concerned about oral toxicity as a result of a single dose or a repeated dose. Particularly we are concerned about the effect of feeding it over a long period of time, perhaps even a lifetime, to a certain species of animals, and then very careful about observation of those animals for any deleterious or adverse effect.

MR. RIEMER: I would like to get back to Dr. Foulger's philosophy of the law. That is something in which I am very much interested. You do not mean to tell me, Dr. Foulger, that what the law says controls what you do in the laboratory. In what sense do you mean that the law blocks the development of these new additives, and so on?

DR. FOULGER: If we accept the fact that very, very few materials are in themselves in *any* quantity, however great, harmless, then of course we are deterred from entering into new fields of application of chemicals to foods if we have no reasonable criterion of safety. The key word in this situation is "required." Many things are desirable but

not required. High-powered, high-compression automobile engines are desirable but not required. If we applied that criterion to many fields, we should stop technological advances in the whole of our life.

MR. SCHWEIGERT: There are other interrelated problems. We mentioned chemical additives. I would like to get back to this question again of radiation sterilization. One of the possible new techniques for the preservation of foods is by sterilizing foods with ionizing radiations. Actually this would be of tremendous interest to the armed forces and other people if we could prepare sterile products by such techniques. Unfortunately, chemical studies have indicated very undesirable off-flavors and odors. And, as all of us realize, acceptability of a food is related to a lot of things besides the nutrient content. It has to taste good; it has to look good; and it has to be the sort of thing for which consumers will create a demand. But these rays, also, possibly could produce deleterious substances, Dr. Foulger; and it would seem to me that we would have to worry about adequate safety tests there, and also for these antioxidents to which we referred. There have been extensive studies on that. I am sure this fits into this whole general thing about which you were commenting.

DR. FOULGER: You certainly do; because if you are producing new substances within that food by your processing, and if those substances can be of themselves harmful, then that food is excluded from interstate commerce under the law. So there is a tremendous amount of research which must be done in the field of sterilization of foods by radioactivity.

MR. RIEMER: And that research is expensive. Any plant which is built in order to capitalize on the research is a high-cost plant. This is one of the places where the law blocks development. Is that not right?

MR. SCHWEIGERT: Even more frustrating is that it is impossible to calculate a lot of the costs on something new like this radiation sterilization, where for peacetime use the Atomic Energy Commission is obviously involved, but no one knows what it would actually cost.

MR. SPENCER: Yet the potentialities in this matter of radiation are tremendous when you think about it. You could control insects very well that way. You can control trichinosis in pork by that method,

and most certainly both fungi and bacteria. We know that we need that whole gamut covered if we are going to distribute our food to the world at large.

MR. SCHWEIGERT: We might well emphasize that, while this is a promising development—one which we think certainly merits much extensive research—it is certainly not right here on top of us at the present time, because there is extensive research work to be done.

For example, the Quartermaster Food and Container Institute of the Armed Forces and the Surgeon General's Office are investigating the very problems which were brought up here about toxicity or wholesomeness—whichever word you particularly prefer for that. Certainly this question of preventing changes in the product, even after it is radiated, cannot be overlooked.

What about degradative reactions, Dr. Foulger, in storage of the particular product? You have to worry about that, not only with this processing method, but with any processing method.

DR. FOULGER: Oh, yes, with any processing method. The protection of foodstuffs in storage is a very important phase of the action of chemicals.

MR. SPENCER: You are most certainly right there. We have a long way to go to protect all the food that we raise. In other words, it is easy to raise food. We may have a lot of food on the ground, but to preserve it or conserve it until it is ready for the ultimate consumer is an important job.

DR. FOULGER: Health is important to all of us, and important to our health is an adequate supply of wholesome, palatable, and attractive food.

MR. RIEMER: One of the drives, I think, of the chemical industry which has been exhibited in this discussion is the effort to grow more food; to protect it after it is grown; and to reduce the cost of its production so as to help meet this farm surplus and farm-labor problem.

MR. SPENCER: I feel that chemistry is meeting the challenge of increasing our food supply and producing more and more food, better foods for the American public, in determining its safety prior to its use.

MR. SCHWEIGERT: I would really like to emphasize some of these aspects on new processing techniques in which chemistry plays a role.

I agree with all you gentlemen that quantity and quality in production are vital; but we have to know how to preserve the food and have adequate processing methods which will keep the product attractive. People want to have a nice-looking product. They want it nutritious. It has to be applied to the specific food habits of a particular population—a point which oftentimes is overlooked in evaluating the possible opportunities for new processing techniques. I often think of the example of vitamin C. One of the richest sources is rose hips, but who eats rose hips? So that something like potatoes, which is lower in vitamin C, is a food which we actually eat a lot of; and in that respect that brings a lot of food into the American diet.

THE IMPORTANCE OF HEALTH IN INDUSTRY*

By JOHN H. FOULGER, M.D.

Director of Medical Research, E. I. duPont de Nemours & Company

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Most people in this world work for a living. Their working capital in the business of life may consist only of health and the ability to do a job. Health is the more important asset. However able and willing to work one may be, continued or even intermittent illness can make the greatest knowledge and the highest skill of low market value.

Health plays an important part in our national standard of living. To attain and maintain a high standard, we must have access to raw materials, the knowledge of how to convert them into useful goods and tools and capital with which to do this, a reservoir of manpower to do the converting, and markets for finished products. No one item can be omitted. The more highly a nation is industrialized, the more the man actually making the goods is identical with the purchaser of those goods. The worker, himself, becomes a basic market unit. Any factor which influences his ability to obtain and to hold employment necessarily affects both production and market. The state of health of the individual worker can be such a controlling factor.

Health as an economic force becomes more important yearly in the United States. Advances in medical science during the last quarter-century have reduced infant mortality, controlled or eliminated many infectious diseases which once produced a high death rate, and greatly increased life-expectancy at all ages. That portion of our population too old or too young to be employed is increasing more rapidly than that portion in the employable age range. Yet financial responsibility for those not employed must always fall upon those who are employed, directly or through taxation. Ill-health of the employed can have a disastrous result. So can ill-health of unemployed dependents.

Our high standard of living is under attack internationally by propaganda or by "cold" or "fighting" wars. The fuel upon which each mode of attack feeds, and often the spark which starts the conflagra-

* From a speech by Dr. Foulger, delivered on the occasion of the dedication of the Haskell Laboratory for Toxicology and Industrial Medicine at the Du Pont Company. Reprinted by special permission.

tion, is found among people who are ignorant, ill-fed, and have a poor standard of personal, physical fitness. Such people are easily seduced by political schemes which promise them a millennium or even what to us would seem but a slight improvement in their daily lot. In our international attempts to protect our way of life we cannot forget that a good preventive medical program in economically backward countries has converted an unemployable population into one of fairly competent workers.

With health assuming such great economic importance, it seems axiomatic that any industry whose operations or products might offer health hazards should do everything it can to learn about them. Most tools or industrial products, if used carelessly or without adequate knowledge, can offer health hazards. An important function of our laboratories will always be the study of toxicity. Data on potential health hazards of new chemicals are used to write adequate precautionary labels on products to conform with federal or state laws regulating transportation, pesticides, and industrial safety. When chemicals are intended to enter the field of food production and processing, more prolonged and detailed toxicological tests are used to satisfy regulations under the Food Section of the Federal Food, Drug, and Cosmetic Act.

Experience has proved that toxicological data alone are not adequate to establish a program of health conservation. To prevent injury from chemicals or manufacturing processes, we must be able to detect changes in physiology which appear before injury to the body organs or tissues. If ignorance or neglect of physiological warnings allow actual injury to occur, we have obviously failed in our duty of prevention. We have learned that at a stage at which definite injury is not yet present, entrance of hazardous chemicals into the body may cause physiological changes not related in any way to chemical structure and, apparently at least, not related to the type of organic damage which might be caused if exposure continues.

The existence of an early, nonspecific physiological influence of a hazardous product brings us at once into a wide field for medical research. Those very advances in medical science which have led to control of infectious diseases and to greater longevity have brought new problems. Since the days of Pasteur and Koch, the doctrine of a specific cause for a specific disease and specific organic damage produced by that cause has dominated medicine. So long as diseases of bacterial or

parasitic origin were of major importance, this doctrine remained powerful in medical teaching and practice. But more than twenty years ago it had been noted that the majority of patients attending clinics for diseases of the digestive tract, for example, were not suffering from specific tissue damage. Increased study of diseases of the heart and circulation has led to the same conclusion. With major infectious diseases under control, it is now recognized that a high proportion of disabling and even fatal illness is due to the accumulating stresses of modern life. These stresses act as insults to the body physiology. The more frequent, or the more powerful, the insults, the more drastic the physiological change required to combat them. Exposure to physiologically active quantities of new chemicals can be such a stress.

To determine the conditions under which one stress—exposure to hazardous chemicals—might threaten health, it was necessary to take into account other stresses, industrial and nonindustrial. Thus, the effects of physical labor, extremely high or low temperatures or humidities, as well as pre-existing disease, became important in selecting workers for a specific job and in protecting them while at the job.

Because in general medicine we deal so frequently now with diseases of stress, due not to one specific cause but to factors operating often over many years, it is obvious that the study of the ultimate outcome, that is, of the ill person, will not give us detailed information on the development of illness. Only by frequent study of many people, attempting to live in a modern environment, resisting or failing to resist stresses of that environment, can we learn more of what we might term the "natural history of stress diseases." Industrial medical practice and industrial medical research offer an unequaled opportunity to study large numbers of people. Development of simple quantitative methods to follow trends in the physiology of those exposed to stress is fundamental to these studies.

We continue our research with the conviction so well expressed many years ago by the British prime minister, Disraeli, that "the health of the people is really the foundation upon which all their happiness and all their powers as a state depend."

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